FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 78 Thursday, April 25, 1946 No. 1549

49, Wellington Street, London, W.C.2
'Grams : " Zacatecas, Rand, London "
'Phone : Temple Bar 3951 (Private Branch Exchange)
PUBLISHED WEEKLY : 21s. per annum (Home and Overseas)

The Patents and Designs Acts

The second interim Report of the Departmental Committee has now been published. There is no recommendation made for any fundamental change in the existing system, which generally speaking has served both the patentee and industry well for many years. However, some changes are suggested so as to limit the possibilities of the law being used to bolster up cartels—either international or national. Amongst several suggestions, the most potent to our mind is the one which has reference to the granting of the rather ridiculous " Patents of Additions " which are taken out purely with the object of lengthening the life of an existing patent. A proposal which has been widely discussed is the endorsing of all patents on grant with the words " Licences of Right," which would reduce it to a right to receive royalties for the use of the patented invention. However, some inventors might be discouraged if they knew that the patented results of their labour would be made available to their competitors. Such an action is not recommended by the Committee.

The administration of the law comes in for strong criticism. It is well known that an action at law on patent matters is liable to favour the money bags; by this phrase we mean public authorities and wealthy industrial concerns, or put the litigants into the Bankruptcy Court. The reason for these heavy costs is because (1) the cases are heard by the Judges of the Chancery Court, who are not normally scientists, and therefore require instructing; (2) the method of " teaching " the Judges is through the use of highly-paid counsel and experts by both sides, and (3) there can be appeals to the Court of Appeal and the House of Lords. To reduce these costs, the Committee recommend the appointment of two Judges from the members of the Bar, who possess scientific or technical attainments, and whose sole job it would be to hear patent actions of law, the Judge to be helped by a scientific assistant. Where an appeal is necessary then the Judge who has not heard the case is to act. After this, the Committee, to our mind, spoil the system by suggesting that in certain cases, where the fundamentals are at stake, then leave to appeal to the House of Lords should be granted. This loophole will still favour the side with the money bags and defeat the otherwise excellent suggestions of the Committee. Another suggestion is that the Comptroller of the Patent Office should be authorised to try cases of alleged infringement when the parties to the case agree to such an action. The Comptroller should have the power in such proceedings to grant relief by way of damages (not exceeding £1,000) but not to grant an injunction. Finally, there is a recommendation that no patent should be granted to inventors who have more disclaimers than claims, and other cases where lack of subject-matter is evident. Such an action would enhance the value of British patents in the international market. Should the recommendations be adopted, industry will watch with interest the repercussions in actual practice. At the moment the wise free lance inventor would be well advised to refrain from exercising his ingenuity in certain well defined fields, as he has but little chance of financial reward. This we are glad to say does not apply to any sections of the foundry industry. Of the few foundry inventions which have been before the courts, it is currently believed that some wrong decisions have been given, mainly because insufficient legal jargon was incorporated in the original specification.

THE AMERICAN FOUNDRYMEN'S ASSOCIATION now has over 8,000 members.

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NOTES FROM THE BRANCHES

EAST MIDLANDS.—The annual meeting of the branch was held at the Derby Technical College on March 30. The branch president, Mr. F. Dunleavy, presided, and the following officers were elected for the 1946-47 session: As branch president, Mr. J. Roxburgh; senior vice-president, Mr. S. A. Horton; junior vice-president, Mr. H. P. Radford; hon. secretary, Mr. S. A. Horton, hon. assistant secretary, Mr. H. Hayden; representatives on the General Council, Mr. A. E. Peace, Mr. G. L. Harbach, and Mr. H. P. Radford; representative on the Technical Council, Mr. A. E. Peace. The following members were elected to serve on the branch council for three years: Mr. A. B. Bill; Mr. W. Niven, and Mr. K. Docksey, and Mr. A. B. Bill and Mr. W H. Smith were elected hon. branch auditors.

Balance Sheet.—Mr. A. B. Bill gave the auditors' report reviewing the financial position for the past year, which in the opinion of the auditors was highly satisfactory. Mr. Bill moved the adoption of the balance sheet for 1945—seconded, and the balance sheet was approved.

Secretary's Report.—As this was the first annual meeting since the cessation of hostilities, a review of achievement of the branch during the war years will no doubt be of interest. The branch membership had increased from 172 in 1939 to 318 in 1946.

Apart from the actual increased membership, branch members' efforts during the war years have been recognised by the award of two E. J. Fox medals, three Oliver Stubbs medals, and five diplomas. The members could therefore feel proud that the branch council in the autumn of 1939 decided to carry on the branch work. Grateful thanks were due to those who accepted office as branch president from 1939 to 1945, namely: Mr. R. H. Buckland, the late Mr. S. E. Dawson, Mr. G. L. Harbach, Mr. W. H. Smith, Mr. F. G. Butters, and Mr. F. Dunleavy.

The lowest attendance at a meeting was in 1943, seventeen members attending the November meeting at Leicester; the largest attendance was the opening meeting of the 1945-46 session, 130 members participating in the visit to Bamfords, Limited, of Uttoxeter. Throughout the war only one meeting was cancelled, and that was due to the very heavy snowfall of February, 1940; the average attendance throughout the war was 50, and 39 meetings were held.

During the present session, eight meetings had been held, and although attendances had not reached the record of the previous session, they were nevertheless extremely satisfactory, the average attendance being 66 against 71 last session. The increased subscription rates were introduced in January of this year, and several resignations can be attributed to this increase, but it is too early yet to say what final effect these increases would ultimately have on membership, and more would be known in a year's time.

In conclusion. the secretary congratulated the retiring president, Mr. Dunleavy, on a successful year of office. Throughout the war members could always be sure that he would somehow attend the meetings, and it was most fitting that his year of office should be the first peace-time session. The meeting closed with a hearty vote of thanks to the president and council for their work during the session, all members present supporting. The annual short Paper competition was then held.

WALES AND MONMOUTH.—At a recent meeting, Mr. C. A. Payne, of Derby, re-presented his Paper on "Consistency and the Cupola." A short discussion followed, of which the following is an abstract.

Answering Mr. Davies, MR. PAYNE expressed a preference for a closed tap hole because an open one varied the air supply. The escaping air was not measurable and thus it disturbed cupola performance. Answering MR. MOSS, the lecturer illustrated by a sketch the details of a slagging spout and suggested that up to 60 in. diameter, one row of tuyeres for servicing the cupola was adequate.

MR. R. JONES stated that he had eliminated the top row of tuyeres in the interests of fuel economy, but this had adversely affected melting conditions.

MR. PAYNE replied that provided the area of the two rows of tuyeres was in correct ratio to diameter of melting zone, then the area of the remaining row should be increased to same aggregate dimensions to ensure adequate air supply. In answer to Mr. Hutchinson, who asked what instruments were necessary in order of importance, Mr. Payne placed first a reliable blast volume and pressure gauge, and next in order, barometer, thermometer and instruments for determining the amount of moisture in the air (a hair-hygrometer or wet and dry bulb thermometer).

Mr. Davies and Mr. Hutchinson each voiced the appreciation of the members of the usefulness of Mr. Payne's Paper, and expressed their personal thanks.

CONTROL OF DOMESTIC HEATING APPARATUS

There were several translation and typographical errors in the article "Control of Domestic Heating Apparatus," which was printed on page 349 of our issue of March 28. The comparison referred to in column 1, lines 16 to 21—a better translation would read, "if, for example, one takes the case of a kitchen stove which consumes 33 lb. of coal with a calorific output of 7,800 calories in an apparatus having an efficiency of 50 per cent., the changeover to a stove of 70 per cent. efficiency represents a daily gain of 9 lb. of coal." In column 2, line 10, for 43,000 read 4,000. Lower down, in line 28, the phrase "permit . . . rate" should read "permit the building up again to the normal rate." Four lines beneath the caption "Testing Procedure," the word "fraction" is a misprint for function, and the first line of page 350, "collects" should read "collates." In the second column of this page, line 9, instead of "carrying an outside wall," read "with normal connection with the outside air." Lines 18 and 22 should read "rules" instead of "dampers," and in line 20, "dampness" should read "airtightness."

CUPOLA OPERATION*

A Review of Logical Cupola Practice

By D. H. YOUNG

For the production of a good casting, two things are necessary: (1) A well constructed mould, and (2) good metal to fill the mould. The first requirement is the work of the craftsman, and the second is also the result of applied knowledge. The most perfect mould can be rendered useless by poor metal, and good metal in a poorly constructed mould will also result in waste.

The cupola is one of the oldest and best servants in the foundry household, and it is unfortunate that, however badly abused, it will continue to give service of sorts. It is worthy of every care and attention, and will respond to good treatment. There is no effect without cause and cupolas are not things of whim and fancy. They are subject to law.

It has been stated that every cupola is a law unto itself. That is simply untrue and it would be more correct to say that many cupola operators take the law into their own hands. In the legal world such action is a punishable offence, and in the foundry world the offence is not without its penalties.

Description of Cupola

A cupola is a tube, closed at one end, open at the other, lined with refractory material. At the closed end there is built up a bed of fuel to which is applied a supply of air for combustion. Onto this bed is charged, in alternate layers, metal and coke. This charge coke is for maintaining the level of the bed as the fuel is consumed. A cupola is therefore a piece of plant for the most efficient burning of coke, to melt metallic iron. Good metal is required for good moulds, and the efficiency of a cupola is not solely a matter of economy in coke consumption. Bad metal will result in scrap and the useless destruction of moulds. Metal with a good degree of superheat can be obtained without heavy coke charges, and whilst excess coke does not result in hotter metal, deficiency of coke will produce inferior metal.

The principal concern, then, in cupola practice, is the most efficient burning of a body of fuel. It is essential to have on tap a constant supply of metal with the required superheat for foundry needs, and in achieving this, to do so with the minimum consumption of fuel. A knowledge of the factors involved will help towards a reasoned solution of the problem.

Procedure

In the cupola a supply of air is passed through the tuyeres at a speed necessary to obtain the maximum combustion rate of the fuel. Here be it noted that any fuel can only generate a certain quantity of heat per unit of weight, and whether or not this quantity of heat is obtained will depend on how completely the fuel is burnt. The rate of burning will depend on a sufficient supply of oxygen being applied to the lighted coke to obtain the maximum temperature. Here, the blast encounters resistance to its passage due to the surface area and structure of the coke.

The surface area of coke, it is evident, will depend, in the first place, on the cupola area, and, in the second place, on the size of the coke. The air encountering this obstruction can only penetrate by different routes in all directions. The tendency is for it to travel upwards the path of least resistance more so than to the centre due primarily to the fact of the opposing tuyere's air stream. A certain distance has to be travelled by the air before maximum combustion takes place, and this plane of maximum combustion is the melting zone. The volume of air, its penetration, its velocity and distribution, are therefore factors to be considered.

As the starting point, the cross sectional area of the cupola determines the quantity of fuel that can be burned in a unit of time, and it is this quantity of fuel which determines the weight of metal that can be melted. The weight of coke determines both the weight of metal and the volume of air necessary for efficient combustion, therefore the larger the weight of coke to be burned for the same weight of metal, the slower will be the melting rate. Stating the weight of metal to coke as a ratio, the melting rate will decrease as the coke ratio increases. It is therefore unwise to state the output of any cupola as so many tons per hour unless the ratio of metal to coke is also stated, whilst to calculate the air required from the tonnage per hour is quite wrong. Used in this way the empirical figure of 30,000 cub. ft. per ton per hour, so often quoted, should not be accepted. For example, consider a cupola of 66 in. dia., capable of melting 15 tons per hour when using a metal to coke ratio of 10:1. If the air required as $\frac{30{,}000 \times 15}{60}$ be calculated, one obtains a figure of 7,500 cub. ft. per min. This volume of air applied to a 66-in. dia. cupola, operating under the conditions mentioned, will never result in an output of 15 tons per hour, the output will be somewhere between 10 and 11 tons per hr. of metal lacking superheat.

The air is for the purpose of burning the coke to produce the necessary heat and for complete combustion, the oxygen content of the air should combine with the carbon of the coke to form carbon dioxide, the condition of maximum reaction. The amount of air therefore depends upon the amount of carbon in the coke, and for every 1 lb. of carbon burning to CO_2, 11.6 lbs. of air are required. The question relates to the weight of air, but the volume of 1 lb. of air varies with barometric pressure and temperature. This fact should be recognised and the necessary corrections made. A definite weight of oxygen is required and it should be ascertained that when the barometric pressure is low and the air light, there is the necessary volume to supply the required weight of oxygen. If the barometric pressure be high, the air is heavy, and

* A paper read before a meeting of the Scottish Branch of the Institute of British Foundrymen, at the Royal Technical college, Glasgow.

A Review of Logical Cupola Practice

for the same weight of oxygen a lesser volume is necessary.

Tables I and II and Fig. 1 are illuminating when one considers the percentage variation that is possible month by month, or even day to day. It gives the answer to the statement so often made, that cupolas

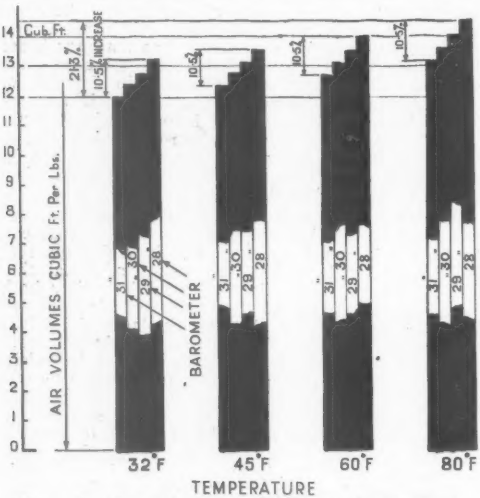

FIG. 1.—RELATIONSHIP BETWEEN ATMOSPHERE CONDITIONS IN CUPOLA BLAST REQUIREMENTS.

melt better some days than others. They probably do, but if attention be paid to the correct weight of air required for combustion, they most certainly would not.

Experience shows that 1 lb. of coke per sq. in. of cupola area can be burned per hour, and with a carbon content of 94 per cent. the air required can be calculated as follows:—

$$\frac{\text{Area sq. in.} \times 1 \text{ lb.} \times 94 \times 11.6 \times \text{Vol. of 1 lb. at N.P.T.}}{100 \times 60}$$

Now consider a 66-in. dia. cupola again, calculated in this manner, the air required when the barometric pressure is 30 and the temperature 60 deg. F., will be:

$$\frac{3{,}421 \text{ sq. in.} \times 1 \text{ lb.} \times 94 \times 11.6 \times 13.07}{60 \times 100} =$$

approximately 8,200 cub. ft. per min.—an increase of approximately 9.3 per cent. This supply of air will give an output with a metal to coke ratio of 10:1 of 15 tons per hr. of metal with a good degree of superheat.

The air per ton per hour is:

$$\frac{8{,}200 \times 60}{15} = 32{,}800 \text{ cub. ft.,}$$

whereas for the previous air supply the air per ton per hour was:

$$\frac{7{,}500 \times 60}{11.5} = 39{,}130 \text{ cub. ft.}$$

Thus it is the cross-sectional area of the cupola, the carbon content of the coke, and the rate of burning of the fuel, that determine the air required—it is not the weight of metal. In cupola operation the air supply is all important and it must be supplied with sufficient velocity and penetration if maximum combustion is to be obtained.

It will be self-evident that less penetration will be required to travel the 24 in. to the centre of a 48-in. dia. cupola than to travel the 33 in. to the centre of a 66-in. dia. cupola. The smaller diameter does not require the same penetration as the larger diameter, therefore the total tuyere area is not a constant ratio to the cupola area for all sizes of cupola. Tuyere size and shape will determine the velocity and penetration. The quantity of air to be delivered will determine the total tuyere area.

Tuyere Areas

The tuyere area will determine the area of blast main, and since there must be a loss due to friction when the blast from the main is split up and discharged through a number of tuyeres, the tuyere area must therefore be greater than the blast pipe area. Most authorities are agreed that these ratios should be approximately:—

	Tuyere : Cupola.	Per cent.
Up to 42 in. ..	1 : 5 to 1 : 6	(20 to 16.6)
44 in. dia. to 62 in.	1 : 6 to 1 : 7	(16.6 to 14)
64 to 90 in. ..	1 : 7 to 1 : 8	(14 to 12.5)
	Blast Pipe : Tuyere.	
Up to 42 in. ..	1 : 1.78 to 1 : 1.56	—
44 to 62 in. ..	1 : 1.54 to 1 : 1.36	—
64 to 90 in. ..	1 : 1.34 to 1 : 1.08	—

Consider a 48-in. dia. cupola; area 1,810 sq. in.; the blast pipe 15¾ in. dia.; area, 195 sq. in., delivering air through a total tuyere area of 288 sq. in., and the blast will tend to flow with low pressure—a desirable condition since the air has only to penetrate 24 in. to reach the cupola centre. In a 66-in. dia. cupola, area, 3,421 sq. in.; blast pipe, 21½ in. dia.; area, 363 sq. in., delivering air over a total tuyere area of 478½ sq. in., the blast will flow with a relatively greater pressure under similar conditions, and as the air has now to penetrate 33 in. to the centre, this is desirable.

Steadiness of Flow

To ensure steadiness of flow over the tuyeres from the blast pipe, a reservoir or wind belt is necessary. The wind belt area should be related to blast pipe area and should be roughly of the order of 4:1. Personal preference is for a large wind belt and the Author feels that many are too small, with the result that there is not an even distribution of an overall tuyere.

It has been established that by starting with the cross-sectional area of the cupola and a rate of burning of the fuel, the volume of air has been decided, and an interdependence and continuity between the

following factors built up: (1) Area of tuyeres; (2) area of blast pipe; and (3) area of wind belt.

The effect of this is to ensure the supply to a bed of incandescent coke, a steady flow of air with the necessary velocity and penetration for the most efficient and even burning of the fuel across the whole cupola area.

In cupola operation the air supply is all important and it should be measured. The volume meter is of greater service than the pressure gauge. Pressure is a necessary evil, it is an impossibility to deliver the required weight of air over the tuyeres with the necessary velocity and penetration without pressure, but if one has, by a reasoned and ordered sequence of areas in the air system, reduced friction as much as possible and thereby kept the pressure at the lowest figure for the air supply, nothing else can be done about it. The other factors decide the rest. These are the fuel, the metal charge, and the height above tuyeres to the charging door. Of these the fuel is the chief offender. Unfortunately, the shaft has to be burnt to get the product, so any resistance it offers has to be overcome. There should be no policy of appeasement or cowardly compromise. One should have the power in the motor to overcome it. Control by pressure is neither wise nor efficient. The basic concern is to supply the weight of air necessary for combustion of the fuel, the pressure can be left to look after itself.

Coke Quality

Good cupola practice requires good coke. The desirable features are:

(*a*).—A cellular structure whereby a large surface area of carbon is exposed to the oxygen in the blast.

(*b*).—It should have a high fixed carbon content, and be capable of sustaining the cupola burden when

TABLE II.—*For Volumes of 1 lb. Air at Various Temperatures and Pressures.*

P.V. = C.T. in Absolute units (for air "C" = 53.2)

At N.T.P. 1 lb. of air occupies a volume $V = \frac{53.2 \times 492}{14.7 \times 144} = 12.35$ cub.ft. (32 deg. F. 14.7 lb. per sq. in.)

Atmos. press. $P = \frac{H \text{ in.} \times 13.598}{2.31 \times 12}$ lbs. per sq. in. for Mercury Barometer.

Barometer H In.	P lbs. per sq. in.	Temperature in deg. F. (Absolute temperature T = T deg. F. + 460). 32 (492)	40 (500)	50 (510)	60 (520)	70 (530)	80 (540)	90 (550)
27	13.25	13.74	13.96	14.24	14.52	14.80	15.08	15.36
28	13.75	13.24	13.45	13.72	14.00	14.26	14.53	14.80
29	14.25	12.77	12.98	13.24	13.50	13.76	14.02	14.28
30	14.70	12.38	12.59	12.84	13.09	13.34	13.59	13.84
31	15.20	11.98	12.17	12.41	12.66	12.90	13.14	13.39

incandescent. In this regard personal experience has shown that cokes with a very low ash content are not desirable, and an ash content of 6 to 7 per cent. seems adequate.

(*c*).—The coke should be capable of rapid combustion, therefore it should not be dense, otherwise penetration by blast is difficult, if not impossible. Neither should it be too soft, for then, when incandescent, it will not stand up to the burden and will tend to burn quickly but inefficiently.

For successful melting, the melting zone has to be maintained at a constant level, and each descending charge of coke will replace that which is burned in melting the previous charge. If this level tends to fall, as it will if the coke burns too quickly and inefficiently, the descending charge will not be of sufficient depth to maintain the bed level, and the result will be that the metal will be chilled by the ascending blast, and dull metal will be the result. On the other hand, if the coke, because of its density or structure tends to burn too slowly, the bed level will rise and dull iron will again be produced.

TABLE I.—*Volume of Air according to Barometer and Temperature.*

$$= \frac{\pi D^2 \times 1 \text{ lb.} \times 94 \times 11.6 \times \text{Volume of 1 lb. Air}}{4 \times 100 \times 60}$$

= cub. ft. per min. C/C 357A

Month.	Barometer, in.	Temperature deg. F.	Cupolas. 48 in. dia. = 1,810 sq. in.	Cupolas. 66 in. dia. = 3,421 sq. in.
January ..	30.6 to 29.5	28 to 32	4,025 to 4,131	7,608 to 7,807
February ..	29.8 to 29.5	60 to 40	4,318 to 4,196	8,162 to 7,932
March ..	29.8 to 30.0	50 to 60	4,236 to 4,305	8,006 to 8,136
April ..	30.3 to 29.5	55 to 60	4,223 to 4,364	7,981 to 8,249
May ..	29.4 to 30.0	55 to 70	4,338 to 4,387	8,199 to 8,292
June ..	29.2 to 30.2	57 to 70	4,381 to 4,358	8,280 to 8,236
July ..	30.2 to 30.0	65 to 75	4,318 to 4,430	8,162 to 8,373
August ..	29.3 to 30.0	65 to 75	4,436 to 4,430	8,385 to 8,373
September ..	30.3 to 29.7	70 to 65	4,438 to 4,377	8,199 to 8,273
October ..	30.3 to 29.2	60 to 60	4,259 to 4,410	8,050 to 8,336
November ..	30.1 to 29.3	55 to 50	4,249 to 4,312	8,031 to 8,149
December ..	28.7 to 30.1	50 to 35	4,400 to 4,081	8,317 to 7,714

The Rôle of Coke

There are two possible reactions when oxygen is applied to the carbon of the coke. These are: (1) 1 lb. of carbon burning to CO_2 generates 14,550 B.Th.U.; (2) 1 lb. of carbon burning to CO generates 4,350 B.Th.U. The CO_2 reaction generates, therefore, over three times the heat of the CO reaction. All coke has a certain rate of combustion which will depend on the nature and extent of the coke surface exposed to the oxygen of the blast.

The time of contact between the oxygen of the blast and the carbon of the coke is very short, too great a density in the coke will not permit of the necessary time contact to permit of the maximum reaction, and slow, dull melting will result. All cokes are of cellular construction and in this respect one coke is very like another, yet all do not give similar results. This dissimilarity will persist in cokes of analyses as near alike as not to matter, and one is forced to the conclusion that as methods of manufacture are fairly standardised the type of coal or the coalfield is a deciding factor.

The structure, then, must be such that the oxygen of the blast during its short time contact with the coke will contact the maximum amount of carbon to give the maximum combustion at the level of air entry. The whole aim is to burn the fuel rapidly and thereby produce a sufficiently high temperature to melt and impart sufficient superheat to the metal. This plane of high temperature is the melting zone.

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Melting Zone

The height of the melting zone above the tuyeres is determined by the velocity and penetration of the blast volume. These factors are determined by tuyere, wind belt, and blast pipe areas correctly related to one another and to the cupola area. If these areas are too small for the volume of air required, high pressure will be necessary to force the weight of air through a restricted area, and melting will then be forced higher up and towards the centre of the cupola, whereas the foundryman's fondness for a soft blast can quite easily lead to such a low velocity over the tuyeres as to lack penetration and the air will trickle up the sides of the cupola and inefficient combustion will result. Too little air is worse than a slight surplus.

Depth of Bed

The proper height of bed can easily be checked by observation as the melting zone is clearly defined by the erosion of the lining. This height is important and when deciding it is worthwhile to take such precautions as to ensure it stays put. It is better to build up the bed from the bottom to above tuyere level and light by means of an oil torch, as one thereby ensures a solid bed of fuel from voids and any tendency to collapse. The height of the bed will vary in cupolas of the same area as the height to charging door increases. This is due to the necessarily increased pressure required to move the greater column of air up the stack. The usual ratio of height to cupola diameter is of the order:

	Height to Dia.
Up to 42 in. dia.	4.5 : 1 to 3.4 : 1
44 to 62 in. dia.	3.4 : 1 to 2.8 : 1
64 to 90 in. dia.	2.8 : 1 to 2.4 : 1

It will also vary with the density of coke being used. It is, therefore, unwise to assume that because a colleague obtains good results with a certain height of bed, this will be done. It will not, unless the conditions are similar to his in all respects. The coke in the cupola bed is the main restriction. In personal practice the Author finds that a level 32 in. above tuyeres gives excellent results. The cupola height to charging door in this case is 18 ft.

The weight of coke between charges will determine the metal charge, but as the weight of coke will vary with its density it is possible for the depth of coke between metal charges to vary. This depth should not be less than 6 in. Personal practice is to check the coke charge periodically by means of a ring 6 in. deep of the same diameter as the cupola. Should the weight of the necessary depth of coke vary to any extent either way, the depth should be maintained and the metal charge altered. It is the coke charge that decides the weight of metal, not the metal charge that decides the coke.

The output in tons per hour will vary with the nature of the charge, size of scrap, etc., and it is generally accepted that 10 lbs. to 12.5 lbs. of metal per sq. in. of cupola area, can be melted per hour per lb. of coke. Therefore, if the metal to coke ratio is 10:1, one will melt in a 48-in. dia. cupola, area 1,810 sq. in.

$$\frac{1810 \text{ sq. in.} \times 1 \text{ lb. carbon} \times 10 \text{ lbs. iron}}{2240} = 8 \text{ tons per hr.}$$

If the ratio be 12.5:1 the melt will be:—

$$\frac{1810 \text{ sq. in.} \times 1 \text{ lb. carbon} \times 12.5 \text{ lbs. iron}}{2240} = 10 \text{ tons per hr.}$$

A claim is sometimes made that by using some particular arrangement one can use less fuel and melt faster. Of course this is possible. It can be done with any coke, but such fuel economy is poor policy if procured at the expense of dull unusable iron. The ratio of metal to coke will depend entirely on the type of iron to be produced and the duty for which it is required. Charges composed of materials with a lower melting point will melt more quickly than charges composed of materials with a higher melting point. Again, large scrap due to its mass will take longer to melt than light scrap.

Heat is required for melting, and in a cupola the material when molten can pass at once from the melting zone. It is not retained in the melting zone as in the reverberatory crucible or rotary furnace. Therefore, materials with a lower melting point remain in the melting zone for a shorter time than those with a higher melting point, and such irons can be melted with less fuel. The product of the cupola must be usable over a reasonable period of time and a good degree of superheat is necessary. Once molten it does not remain so for any length of time, and combustion should therefore be such that the hottest possible zone is obtained through which the dripping metal passing on its way to the well becomes superheated.

The melting point of the iron or steel will determine the length of time the metal remains in the melting zone, and it is this time lag that is responsible for the fact that mixtures diluted with steel can be tapped at higher temperatures than ordinary mix irons.

The Author's practice is to build to above tuyere level and light by oil torch. The furnace is kindled about 11 a.m. each morning. After the bed has burned through, charging is commenced and the cupola is kept charged to charging door level. Blast is put on at 1.15 p.m. In the 48-in. dia. cupolas, the metal charge is 1 ton, and for the 66-in. dia. cupola 2-ton charges are employed.

Metal to Coke Ratio

The metal to coke ratio is 10:1. All metal charges are weighed and all metal returns from the floor are kept separate. Strict control is maintained and all mixtures are kept within strict limits. If it is not known what goes into the cupola, it is difficult to say what comes out of it. Control is necessary—No. 3, No. 4 or any other pig iron can have large variations in silicon. Due to the fact already mentioned that the metal does not remain for any length of time in the melting zone, it is not good practice to make up charges with metals of widely varying melting points.

The charges for the highest silicon content irons are charged first, graduated down to the lowest silicon

(*Continued on page* 439.)

INSTITUTE ELECTS NEW MEMBERS

At a meeting of the Council of the Institute of British Foundrymen, held at the Midland Hotel, Derby, on April 6, the following were elected to the various grades of membership.

FIRST LIST

As Subscribing Firm Members

Incandescent Heat Company, Limited, Cornwall Road, Smethwick, Staffs, metallurgical plant manufacturers and ironfounders (representative, J. Fallon); R. Thomas & Baldwins, Limited, 47, Park Street, London, W.1 (representative, Gwilym Rees).

As Members

W. Aal, metallurgist and engineer, R. S. Stokvis & Zoon, Amsterdam; A. B. Bates, foundry manager, Winsford Foundry, Winsford, Ches.; J. R. C. Brain, foundry manager, Thomas Green & Company, Coseley Foundry, nr. Bilston; C. Davies, foundry manager, Crane Foundry Company, Limited, Wolverhampton, B. I. Evans, foundry manager, Incandescent Heat Company, Birmingham; E. A. Fawcett, proprietor, H. Summersgill, Bradford; J. A. Hamilton, B.Sc., metallurgist, W. McPhail & Sons, Limited; Glasgow; T. Lee, director, Henry Hollingdrake & Sons, Limited, Stockport; F. V. Lewis, B.A.(Hons.), metallurgist, Birlec, Limited, Birmingham; A. McBean, B.Sc., foundry superintendent, Kumardhubi Engineering Works, India; T. R. C. Muir, metallurgist, Railway Workshops, Wellington, New Zealand; E. G. Seager, production manager, A. L. Dunn & Company, Limited, Coventry; E. W. J. Smith, chief engineer, Crane Foundry Company, Limited, Wolverhampton; G. J. Westwood, foundry foreman, South Staffs Foundry, Limited, Wolverhampton; K. F. Whyman, A.C.I.S., auditor and cost investigator, Aircraft Equipment, Limited, Warrington; E. Kay,* general manager, Gloucester Foundry, Limited; F. E. Steele,* foundry manager, C. & J. Hampton, Limited, Sheffield.

*Transferred from Associate Member to Member.

As Associate Members

W. O. Arnott, draftsman, Albion Motors, Limited, Glasgow; G. Ashford, foundry foreman, Deloro Stellite, Limited, Birmingham; A. Blakemore, metallurgist, Stanton Iron Company, Limited; K. J. F. Bradbury, metallurgist, Midland Electric Manufacturing Company, Limited, Birmingham; W. J. Campbell, assistant metallurgist, Wycliffe Foundry & Engineering Company, Limited, Lutterworth; C. Dewfall, draftsman, Guest Keen & Nettlefolds, Limited, Port Talbot; A. C. Edwards, metallurgist, Simplex Electric Company, Limited, Oldbury; G. B. Flewitt, manager, Flewitt, Limited, Birmingham; R. Gray, technical adviser, T. E. Gray & Company, Northampton; E. Godber, assistant foundry manager, Laycock Engineering Company, Limited, Sheffield; A. E. Hall, mechanical engineer, J. Hutchinson & Company, Pontypridd; J. A. Harrison, works manager, T. Green & Company, Coseley; L. R. Holladay, pattern-maker, Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees; A. Hollowood, foreman pattern-maker, Hill Top Foundry Company, Wallsall; V. L. T. Hunt, planning engineer, General Electric Company, Limited, Witton; K. Jung, metallurgist, Renfrew Foundries, Limited, Hillington; H. King, moulder, P. R. Jackson & Company, Limited, Salford; M. M. Labib, B.Sc., demonstrator, Fouad 1st University, Giza, Egypt; A. D. Littley, foundry manager, Rudge Littley, Limited, West Bromwich; E. Lloyd, assistant foreman, John Williams & Sons (Cardiff), Limited, D. Marles, research metallurgist, B.C.I.R.A., Birmingham; W. Mayers, pattern-maker, John Fowler (Don Foundry), Limited, Sheffield; A. Mitchell, foreman moulder, Bellow Machine Company, Limited, Leeds; J. B. Morton, technical executive, G. & J. Weir, Limited, Glasgow; A. Pearson, core-shop foreman, John Fowler (Don Foundry), Limited, Sheffield; S. A. Piper, technical representative, Constructional Engineering Company, Limited, Birmingham; J. Weatherell, foreman moulder, Blackett Hutton & Company, Limited, Guisborough; D. P. Wilson, foundry manager, Bertrams, Limited, Edinburgh; T. Winterbottom, foreman pattern-maker, Howard & Bullough, Limited, Accrington; L. A. Whitham, technical representative, Midland Monolithic Furnace Lining Company, Limited, Northampton; D. E. Arundel,* Worthington-Simpson, Limited, Newark; A. G. Farnsworth,* research engineer, Rolls Royce, Limited, Derby; S. P. Russell,* assistant foundry manager, S. Russell & Sons, Limited, Leicester; A. Archer, assistant foreman, John Fowler (Don Foundry), Limited, Sheffield.

*Transferred from Associate Member.

As Associates (over 21).

J. Cowie, Jnr., apprentice metallurgist, Fullwood Foundry Company, Limited, Mossend; P. Mulcahy, foundry foreman, Coneygre Foundry, Tipton; A. J. Swales, apprentice moulder, Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees; A. Woods, apprentice mechanical engineer, Austin Motor Company, Limited, Longbridge.

As Associates (under 21).

K. Coe, apprentice, H. Summersgill, Bradford; H. S. Giblett, assistant metallurgist, Blackstone & Company, Limited; Stamford; J. G. Johnson, foundry apprentice, J. Harper & Company, Limited, Willenhall, F. A. Sheard, apprentice pattern-maker, Elliot Musgrave, Bradford; S. Williams, foundry apprentice, English Electric Company, Limited, Bradford; H. Wilson, foundry apprentice, English Electric Company, Limited, Bradford.

SECOND LIST

As Subscribing Firm Members.

Grafton Tools, Limited, Station Works, Colindale Avenue, London, N.W.9, machine tool makers (representative, F. G. Cooke); Metters, Limited, Australia, ironfounders and builders' engineers (representative, W. Thomas).

Institute Elects New Members

AS MEMBERS

J. A. Orpin, works development engineer, J. & E. Hall, Limited, Dartford; E. Farrar,* superintendent, C.V.A. Jigs, Moulds & Tools, Limited, Hove.

*Transferred from Associate Member.

AS ASSOCIATE MEMBERS.

S. R. Bridger, steel castings inspector, Lake & Elliot, Limited, Braintree; L. Crowter, ratefixer, Vickers Armstrong, Limited, Dartford; W. Fraser, assistant foundry metallurgist, W. G. Armstrong Whitworth & Company, Limited, Newcastle-upon-Tyne; B. R. Lock, moulder, Lake & Elliot, Limited, Braintree; E. McCutcheon, sales manager, Parlanti Art Foundry, London; E. Patterson, metallurgical chemist, Vickers Armstrong, Limited, Gateshead; T. S. Rangaswamy, B.Sc., (Met.), metallurgist, Cooper Engineering, Limited, Bombay; S. Webster, foreman moulder, Gloucester Foundry, Limited; D. F. Knight,† metallurgical chemist, Winget, Limited, Rochester.

†Transferred from Associate.

AS ASSOCIATE (OVER 21).

J. D. Owen, machine moulder, C. A. Parsons, Limited, Newcastle-upon-Tyne.

AS ASSOCIATES (UNDER 21).

E. L. Fisher, laboratory assistant, K. & L. Steel Founders, Limited, Letchworth; G. French, laboratory assistant, K. & L. Steel Founders, Limited, Letchworth.

THIRD LIST

AS MEMBERS

H. Hulme, works engineer, Harrison McGregor & Company, Limited, Leigh; T. Johnston, foundry manager, James Robertson & Sons (Fleetwood), Limited; C. J. Walker, works manager, P. R. Jackson & Company, Limited, Salford; W. H. Wright, technical representative, British Pigirons, Limited, London; D. Knowles,* research metallurgist, Hadfields, Limited.

*Transferred from Associate Member.

AS ASSOCIATE MEMBERS.

J. Chippendale, moulder, J. Robertson (Fleetwood), Limited; S. Holding, foreman moulder, F. R. Cass, Limited, Bury; R. D. Howe, pattern maker, Staveley Coal & Iron Company, Limited, Chesterfield; W. T. Palmer, moulder, P. R. Jackson, Limited, Salford; E. R. Unwin, mechanical engineer, Samuel Osborn & Company, Limited, Sheffield; D. Whitaker, partner, Horsforth Ganister Company, Leeds.

AS ASSOCIATES (OVER 21).

C. Greenwood, chargehand moulder, Sandholme Iron Company, Limited, Todmorden; J. Chappell, apprentice moulder, Imperial Foundry Company, Leamington Spa.

AS ASSOCIATE (UNDER 21).

B. Edwards, apprentice moulder, Cudworth & Johnson, Limited, Wrexham.

FOURTH LIST

AS MEMBER.

D. E. Bowsie, buyer, W. Macfarlane & Company, Glasgow.

AS ASSOCIATE MEMBERS

A. Jamieson, metallurgist, G. & J. Weir, Limited, Glasgow; D. Kinnon, foundry chemist, Babcock & Wilcox, Limited, Renfrew; T. Miller, assistant foreman moulder, Harland & Wolff, Limited, Glasgow; H. E. W. Quixley, pattern-maker, Alley & MacLellan, Limited, Glasgow; G. Raphael, moulder, Harland & Wolff, Limited, Glasgow; A. Stirling, foreman moulder, Shaw Glasgow, Limited, Glasgow; W. Nicholson, moulder, The Mirlees Watson Company, Limited, Glasgow; J. Lawrie, foreman moulder, The Mirlees Watson Company, Limited, Glasgow.

AS ASSOCIATE (OVER 21).

R. Morrison, assistant foreman moulder, Shaw Glasgow, Limited, Glasgow.

AS ASSOCIATE (UNDER 21).

J. Murdoch, apprentice moulder, The Mirlees Watson Company, Limited, Glasgow.

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

DEFECTIVE CASTINGS DUE TO FAULTY CORES IN A MALLEABLE FOUNDRY

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—On reading the above article by Mr. Lane and Mr. G. W. Fearfield, published in the issue of February 21, I was surprised to note their remarks concerning the scabbing of cores.

They stated: "Where a core is bedded in black sand, it creates steam and destroys the face of the core"—which is true, but, if they will do what I suggest, they will obtain the results they desire.

Take a piece of soft brown paper about the size of the core to be made, dip it in core oil, and then place it on the core; next, add the bedding sand. Also, if it is a case of a deep bed of black sand, then place two tubes about 2 in. in diameter, one end to touch the frame. This will help the steam to get away. I have had this done for the last 20 years, with good results.—

Yours, etc.,
S. HODGKISS
(foreman coremaker).

8, Albany Road, Rochester.
April 11, 1946.

PROF. K. GIERDZIEJEWSKI has been appointed director of a new Foundry Research Institute situated at Krakow, Poland.

TINNING OF CAST IRON*

By R. A. CRESSWELL, M.Sc.

[SLIGHTLY ABRIDGED]

INTRODUCTION

Cast iron is tinned either to give it a non-toxic, corrosion-resistant coating, typically for food-processing equipment, or to facilitate the adhesion of a white-metal layer, as in bearings. It is well known that cast iron cannot be tinned satisfactorily by the methods commonly used for tinning steel or copper. This is because: (*a*) Iron castings have a hard skin, containing a high percentage of silicon, graphite, etc., which must be removed before satisfactory tinning can be effected; (*b*) about 10 per cent. of the clean surface area of cast iron is graphite, to which tin does not adhere; (*c*) pickling acids readily attack the iron, leaving a black film of graphite sludge which is difficult to remove and which prevents effective tinning; (*d*) owing to the high ratio of weight (heat capacity) to surface area of most iron castings, the tin coating solidifies slowly, with the result that there is ample opportunity for dewetting (retraction of the tin into droplets) to occur.

In view of the difficulty of tinning cast iron directly, it is usual first to deposit electrolytically a coating of pure iron (or occasionally copper), which can afterwards be tinned more readily.

The object of the present research was to evolve methods for hot-tinning cast iron directly, *i.e.*, without the application of an intermediate metal coating. The influence of modifications in the successive stages of cleaning, pickling, fluxing, and tinning was first studied, but it was found later that better tinning was obtained by departing from the above sequence and preparing the cast iron for tinning by treatment in fused salts.

Fused-Chloride Method

Treatment of cast iron in fused salts, as an alternative to the processes of degreasing, pickling, and fluxing in aqueous solutions, was investigated with a view to reducing the number of preliminary operations before tinning and also avoiding as far as possible the use of aqueous solutions.

A number of fused-chloride mixtures were found to remove rust from iron and steel at 300 to 400 deg. C., among which mixtures of zinc chloride, stannous chloride, and sodium chloride were investigated in detail. The best results were obtained with the zinc-chloride-sodium-chloride eutectic (17.8 wt.-per cent. of sodium chloride, melting point 262 deg. C.), which was more fluid at tinning temperatures than the other mixtures and more rapid in its action on the iron.

It was found that immersion of a mechanically cleaned cast-iron article in the fused-chloride mixture could with advantage take the place of degreasing, pickling, and fluxing; the coatings obtained by subsequent dipping in the tin bath were brighter, more uniform, more corrosion-resistant and had better adhesion. This method is entirely satisfactory for compact, non-porous castings, the surfaces of which have been adequately prepared by mechanical means, and where good corrosion-resistance and moderate adhesion strength is required. The practical details of operation of this new tinning process are given below.

Practical Procedure

Mechanical Cleaning.—Machining, grinding, sand- or shot-blasting may be used. Machining or grinding gives the best results.

Stopping-off.—Portions of the surfaces of articles which are required to be stopped-off from tinning (*e.g.*, the backs of bearing shells) are painted with a thin wash containing 25 wt.-per cent. of magnesia, 50 wt.-per cent. of water-glass, and 25 wt.-per cent. of water.

Preheating.—It is desirable to preheat large articles in an oven at 200 to 250 deg. C. before immersion in the salt bath. To avoid oxidation of the mechanically cleaned surfaces during preheating they are painted over with a solution containing 25 wt.-per cent. of zinc-chloride-sodium-chloride eutectic mixture.

Salt-Bath Treatment.—The article is immersed in a molten mixture of zinc chloride (82 parts by weight) and sodium chloride (18 parts by weight), kept in a welded Monel metal container,† and heated by Monel-sheathed electric immersion heaters to maintain a temperature of 300 to 350 deg. C. Owing to cooling, an envelope of solid salt forms on the iron, but this melts after one or two minutes, or more rapidly if the article has been preheated. A suitable time of immersion is 20 to 40 sec. after the envelope has melted, as detected by moving the article in and out of the bath. The time should not be prolonged beyond that necessary to give a satisfactory coating; over-treatment darkens the surface of the iron and poor tin coatings result.

First Tin Pot.—The articles are transferred to the first tin pot directly from the salt bath. The tin, kept at 300 deg. C., is completely covered with a thin layer of the fused-chloride mixture, which is automatically renewed by carry-over from the fused-salt bath. The duration of immersion should be at least 3 to 5 min.; longer times (up to 30 min.) give better adhesion.

Second Tin Pot.—This is kept at 240 to 260 deg. C. and the tin is almost completely covered with palm oil, tallow, or a mineral-base tinning oil. It is employed where a bright and corrosion-resisting tin coating is required, but in many cases (*e.g.*, pre-tinning bearing shells) is unnecessary.

Draining and Cooling.—The articles may be drained and cooled in air, or quenched in paraffin oil. Quenching gives a thicker and more brilliant coating and is necessary with thick sections of iron in order to avoid excessive draining and yellow stain due to oxidation. The quenching bath may consist of a layer of paraffin

*A Paper prepared for presentation to the Iron and Steel Institute. The Author is on the staff of the Tin Research Institute.

†Cronite also makes a satisfactory container.

Tinning of Cast Iron

oil about 2 in. thick on top of cold water. The tinned article is lowered slowly through the oil layer so that the tin solidifies in the oil.

Microscopical Investigation

Examination after Fused-Salt Treatment.—After suitable preparation, cast-iron specimens were immersed in the fused-chloride bath for different times, washed in water, plated with copper, and sectioned for polishing and microscopical examination. With times of immersion up to one or two minutes, the surface of the iron was left clean. There was some evidence of removal of graphite from flakes without deposition on the neighbouring iron surface. After immersion for 5 min. the surface showed an accumulation of graphite, resembling that produced by over-pickling in acid. This corresponds with the deterioration of tinning quality and adhesion observed on extending the time of salt-bath treatment to 5 min.

Examination after Tinning.—Cast-iron specimens, after the selected pre-treatment, were tinned, immediately quenched in paraffin oil in order to give as thick a tin coating as possible, and sectioned and prepared for microscopical examination as above. There is no accumulation of graphite sludge between the tin and iron, and the tin is seen to bridge over graphite flakes.

While the main cause of discontinuity of tin coatings on cast iron appears to be the presence of graphite at the surface of the iron, certain other possible causes have also come to light, namely, adhering flux spots and gas evolution from the iron.

In general, the fused-chloride treatment leaves a clean iron surface, which favours contact between the tin and iron over the whole surface, leading to continuous, adherent coatings. Graphite from flakes shows little tendency to spread along the iron surface, in contrast with acid pickling, but after prolonged treatment, there is a tendency for graphite to accumulate at the surface and then the tinning quality deteriorates.

Resistance to Corrosion

Coatings of tin on iron and steel, even when good in appearance, are often discontinuous or porous. These pores form centres of corrosion, from which rusting may subsequently spread over the whole article.

The porosity of the coatings produced by different tinning methods was determined by the hot-water test.[1] All the specimens tinned after preparation by pickling procedures were very porous, although the porosity was considerably reduced in decarburised and shot-blasted specimens. The coatings produced by the fused-chloride method were remarkably free from pores. The greatly reduced porosity of the coating produced after treatment in the fused-chloride bath is notable, and the improvements over standard procedure gained by pickling in cold mixed acids (slab *c*) and decarburising and shot-blasting (slab *d*) are also apparent.

Similar results were obtained in outdoor exposure tests.

Tinning Cast-Iron Shells for Bearings

Cast-iron bearing shells are tinned as a preliminary step to lining with white-metal alloys, but trouble is generally experienced owing to lack of adhesion of the white metal to the cast iron, and mechanical keying is usually provided.

Adhesion tests on a series of cast-iron bearing shells by a number of different procedures and lined with a high-grade white-metal bearing alloy (89.5 per cent. of tin, 7 per cent. of antimony, 3.5 per cent. of copper) have been carried out by the technique described by Chalmers.[2] Three determinations were made on each shell and the results are given in Table I.

TABLE I.—*Adhesion Tests on White-Metal-Lined Cast-Iron Bearings.*

Shell No.	Treatment before Lining.	Adhesion values, tons per sq. in.			Range of values, tons per sq. in.
1	Standard tinning ..	1.4	0	0	0 –1.8
2	,, ,, ..	0	1.8	0.7	
3	Mixed acid pickling and tinning	0	0	1.1	0 –1.8
4	,, ,, ,,	1.8	1.6	X	
5	Copper plated and tinned	0	0	0	0 –2.6
6	,, ,, ,,	1.8	0	2.6	
7	Iron plated and tinned	3.2	2.9	3.1	0.9–3.2
8	,, ,, ..	2.9	0.9	X	
9	Electro-tinned(0.0005in., stannate bath) ..	0	0	0	0
10	Electro-tinned(0.0005in., acid bath)	0	0	0	
11	Tinned by fused-chloride method	2.0	2.2	2.3	2.0–2.8
12	,, ,, ,,	2.5	2.6	2.8	

When 0 is recorded, the lining became detached during sawing or drilling; adhesion is small and indeterminable. When X is recorded, no value could be measured because the lining was forced off by undue strain during sawing or drilling (*e.g.*, jamming of the drill).

The outstanding feature of these results is that adhesion values obtained after preparation for tinning by the fused-chloride method are consistently superior to those obtained by pickling procedures. With acid pickling, the adhesion of the white metal to the iron was often insufficient to withstand sectioning and polishing. The adhesion now obtainable is also superior to that measured for copper-plated cast iron, in which failure occurs in the plated layer. The only process giving higher adhesion values is the preliminary electrodeposition of iron on the cast-iron surface, which introduces operational disadvantages.

Electroplating with tin appears from these tests to be an unsatisfactory alternative to hot-tinning preparatory to lining cast iron with bearing metal. Before electro-tinning, the shells were machined, degreased, and pickled in cold 75 vol.-per cent. hydrochloric acid, and the possibility remains that other cleaning treatments before electro-tinning might give better results.

Microscopical Examination of the Iron-White-Metal Bond

Specimens lined with white metal after machining, pickling, and tinning were characterised by the presence of graphite at the iron-white-metal interface and the almost total absence of tin-iron compound.

Machined specimens, treated in the fused-chloride bath, tinned and white-metalled, showed absence of graphite at the white-metal boundary and the presence of a fairly uniform and continuous layer of iron-tin compound.

Specimens were examined microscopically after copper-plating, tinning, and white-metalling and after iron-plating, tinning, and white-metalling. With the copper-plated specimen there was a thick continuous compound layer between the copper and the tin. With the iron-plated specimen the electrodeposit has formed continuously over both the cast-iron and graphite surfaces.

Tinning by Wiping (Modified Chloride Method)

The procedure described below is suitable for tinning objects which are too large to be dipped, such as marine bearing shells, and it also permits the tinning of selected parts of the surfaces of articles, such as insides of large pans, without recourse to extensive stopping-off.

The sequence of operations is as follows: (1) The surface to be tinned is mechanically prepared by machining, shot-blasting, or sand-blasting. (2) The surface is brushed with a solution containing 25 wt.-per cent. of zinc-chloride-sodium-chloride eutectic mixture and the article is heated to 270 to 300 deg. C. The application of aqueous flux effectively prevents oxidation during heating; (3) An appropriate quantity of previously melted zinc-chloride-sodium-chloride eutectic flux is poured on to the surface at 300 deg. C. and washed over the surface for 1-2 min., the article being rocked gently if possible. To facilitate application of the flux, it is preferable to enclose the area to be tinned so as to constitute a bath. For example, the ends of a large bearing shell may be closed with steel plates; and (4) Any excess of flux is then removed; a quantity of molten tin is poured on to the surface to be tinned, and wiped over the surface by means of steel wire brushes or scrapers. When tinning is complete, excess metal is allowed to drain off and the article allowed to cool, and any flux residues are removed by washing.

The operations of the process should follow one another as quickly as possible. If there is delay between operations (1) and (2) and slight oxidation or rusting has occurred, the tinning surfaces may be brushed over with cold 50 per cent. hydrochloric acid or cold 10 per cent. hydrofluoric acid immediately before operation (2).

The relatively few adhesion values that have been determined on shells lined by the wiping technique were rather lower than those on shells tinned by the dipping process. This is not surprising in view of the difficulty of control.

The Fused-Nitrate Method

The alternative method of preparation described below was devised with the aim of removing surface graphite flakes from the iron by oxidation before tinning. Two advantages are thus secured: graphite no longer breaks the continuity of the iron-tin boundary layer, and the cavities formerly occupied by graphite can be filled with tin, thus mechanically enhancing bond strength.

Immersion in fused alkali nitrates was found to be a convenient way of oxidising the graphite. The most suitable oxidising treatment is immersion for 15 min. at 350 to 400 deg. C. in the fused sodium-nitrate-potassium-nitrate eutectic (51.3 per cent. potassium-nitrate, melting point 219 deg. C.). During the treatment the iron is oxidised superficially, acquiring a blue scale which must be removed before tinning can be effected.

The effect on tinning quality of oxidation in fused nitrates followed by various scale-removing treatments has been investigated, the quality of the tin coatings being judged by determination of adhesion and by examination of microstructure.

The microscopical examination confirmed that the fused-nitrate bath removes graphite from flakes at the surface of the iron and also removes the black film which is produced on iron after over-pickling. The tin penetrates into the cavities formerly occupied by the graphite, particularly when these are first opened up by pickling in sulphuric acid. This gives added mechanical bonding. In a few experiments where preliminary pickling was omitted, the penetration of the tin into the cavities was less complete.

These experiments led to a more detailed examination of tin coatings obtained after various sequences of operations based on the following general principles: (*a*) "Opening up" graphite flakes by pickling; (*b*) oxidation of graphite by treatment in a fused-nitrate bath; (*c*) removal of iron oxide scale (produced in the nitrate bath) by acids; (*d*) removal of silica by hydrofluoric acid. (This also removes iron oxide scale.)

Each stage was varied in turn in order to discover the optimum conditions, quality being judged by determination of adhesion and examination of microstructure. During tinning the pot temperature was kept at 300 deg. C., the time of immersion being 5 min. Each specimen was in the form of a bearing shell and, after tinning, was lined with a tin-rich white metal (tin 89.5 per cent., antimony 7 per cent., copper 3.5 per cent.) under standardised conditions. A large number of adhesion tests were carried out (six on each shell), and a selection of the results is given in Table II and discussed below.

In preparing the specimens for micro-examination, sections were made so that three different parts of the specimen could be examined, *viz.*, the iron-white-metal boundary, the fractured bond, and the tinned back of the shell (which was unmachined).

Discussion of Results

Variation of the Preliminary Pickle.—Pickling appears to open out the graphite flakes, thus facilitating oxidation of the graphite by fused nitrate in the next operation and when omitted the adhesion is poor. Moderate pickling also tends to roughen the surface, which mechanically assists adhesion. The best results were obtained by pickling for 30 sec. in hot 10 wt.-per cent. sulphuric acid at 85 deg. C. (inhibited with 0.5 g./litre of Stannine) or in cold 50 vol.-per cent. hydrochloric acid for 5-30 min. Almost equally good results were obtained by immersion for 5 min. in cold 10 vol.-per cent. hydrofluoric acid or in a cold mixture of

Tinning of Cast Iron

5 vol.-per cent. hydrofluoric acid + 5 vol.-per cent. sulphuric acid. Cold hydrofluoric or hydrofluoric-sulphuric acid has the advantage of removing any silica residues.

Variation of the Oxidising Bath.—It was found that the temperature of the nitrate bath could be reduced from 450 to 350 deg. C. without impairing the quality of tinning, but further reduction of temperature lowered the effectiveness of the treatment. The optimum immersion time for the cast-iron shells used was 15 min.

It was hoped to remove graphite and silica simultaneously from the cast-iron surface by adding hydrofluoric acid (as potassium hydrogen fluoride) to the nitrate bath, but the amounts added (1-5 per cent.) did not improve the process.

Variation of After-Treatment.—Cold 10 vol.-per cent. hydrofluoric acid is the best agent for removing the scale produced on the iron in the nitrate bath; the fused-chloride bath is less effective.

Practical Procedure

The article is mechanically cleaned by machining, shot-blasting, or sand-blasting, and degreased in trichlorethylene vapour or a hot alkaline metal-cleaning solution. It is pickled in 10 wt.-per cent. inhibited sulphuric acid (inhibitor: 0.5 g./litre of Stannine) at 85 deg. C. for (say) 30 sec., or in cold 50 vol.-per cent. hydrochloric acid for 2-5 min., rinsed in water, and dried. The article is then immersed in a fused mixture of equal parts by weight of sodium nitrate and potassium nitrate, contained in an ordinary welded-steel or cast-iron pot and heated at 350 to 400 deg. C. by gas burners or other convenient means. Ordinarily the time of immersion required is 15 min. The treatment oxidises surface graphite, and produces an oxide film on the surface of the iron. The latter is removed, after washing off excess nitrates with cold water, by further pickling in cold 10 vol.-per cent. hydrofluoric acid for 1 min. After rinsing, the article is fluxed in an aqueous solution of the zinc-chloride-sodium-chloride eutectic and tinned as described for the chloride method.

The nitrate method is capable of producing good tin coatings on all classes of machinable non-alloyed cast irons. The adhesion values are superior to those obtained by using the chloride method, being consistently of the order of 3 tons per sq. in.

From experience with various irons, it appears that the duration of the first pickling treatment must be suited to the particular iron being used. The optimum time must be found by experiment, but it is usually within the range of 15-60 sec. when using 10 per cent. sulphuric acid at 85 deg. C.

Industrial Applications

Both fused-salt methods of tinning have been used successfully on an industrial scale. The fused-nitrate method has been found particularly suitable for tinning small and medium-sized cast-iron bearing shells, where good adhesion is essential. A typical series of adhesion values for a cast-iron shell, tinned by the

TABLE II.—*Adhesion Tests of White-Metal-Lined Cast-Iron Bearings Prepared by the Fused-Nitrate Method.*

Specimen No.	Stages of Tinning Procedure.			Adhesion Values at Various Positions on the Shell, tons per sq. in.						Average Strength, tons per sq. in.
	Preliminary Pickle.	Oxidising Bath (KNO_3–$NaNO_3$ eutectic).	Subsequent Treatment.	1.	2.	3.	4.	5.	6.	
1	30 sec. in 10 per cent. H_2SO_4 (inhib.) at 85° C.	15 min. at 450° C.	60 sec. in cold 10 per cent. HF	3.8	3.8	3.3	2.9	3.3	2.8	3.3
6	30 sec. in 10 per cent. H_2SO_4 (inhib.) at 85° C.	15 min. at 350° C.	As for No. 1	3.0	2.5*	3.2	3.6	3.0	X	3.2
7	5 min. in cold 10 per cent. HF	As for No. 6	As for No. 1	2.4	2.8	2.3†	3.4	2.0†	X	2.9
8	5 min. in cold 5 per cent. HF + 5 per cent. H_2SO_4	As for No. 6	As for No. 1	2.6	X	2.3†	2.6	2.8	3.0	2.8
43	10 min. in cold 50 per cent. HCl	15 min. at 350° C.	As for No. 1	3.0	1.4*	2.6	2.8	3.1	2.8	2.9
9	30 sec. in 10 per cent. H_2SO_4 (inhib.) at 85° C.	10 min. at 350° C.	As for No. 1	1.8	2.5	2.9	2.3	2.1	X	2.3
12	As for No. 9	15 min. at 300° C.	As for No. 1	1.3	X	X	2.3	1.7	1.5	1.7
17	As for No. 9	15 min. at 350° C., but with 5 per cent. KHF_2 added	As for No. 1	2.8	2.8	2.6	2.1*	2.6	2.6	2.7
20	As for No. 9	15 min. at 450° C.	2 min. in cold 50 per cent. HCl	2.1	2.4	1.9	1.9	1.9	2.6	2.1
27	As for No. 9	15 min. at 350° C.	60 sec. in 10 per cent. HF, followed by 30 sec. in fused-chloride bath at 300° C.	3.6	2.7	2.9	3.5	2.6	1.3*	3.0
23	As for No. 9	As for No. 27	30 sec. in fused-chloride bath at 300° C.	X	1.6	1.8	0	0	0	<1.7

* Oxide under white metal. † Hole eccentric.

When 0 is recorded, the lining became detached during sawing or drilling; adhesion is small and indeterminable. When X is recorded, no value could be measured because the lining was forced off by undue strain during sawing or drilling (*e.g.*, jamming of the drill).

fused-nitrate method and lined with tin-base bearing alloy under industrial conditions is as follows:—

Adhesion Values, tons per sq. in.			
2.5	2.4	2.6	2.2
3.3	2.5	2.4	1.4

The general experience in this laboratory in testing commercial bearings of this type is that the adhesion values normally vary between 0 and 1 ton per sq. in.

The technique for tinning by wiping (modified chloride method) has been successfully tried out on a number of large cast-iron bearing housings for marine engines, Diesel engines, electric generators, etc. For those purposes where appearance is of greater importance than adhesion (*e.g.*, in food-processing equipment, such as mincing machines, saucepans, etc.) the fused-chloride dipping method has proved satisfactory. Both the fused-chloride and fused-nitrate methods have been used for tinning small cast-iron components in order to facilitate subsequent assembly by soldering or sweating.

Where articles or components can conveniently be tinned by total immersion, the nitrate method is the more flexible and reliable, and has the advantage that no special tank or heating equipment is required for the fused salt.

Since no previous pickling treatment is used in the chloride process, a rather higher standard of mechanical cleaning is required than with the nitrate process. A disadvantage of the chloride method is that when tinning porous castings (and porosity is not infrequent) the flux may penetrate deeply into the pores and will not be completely removed in the tinning operation. This may cause sweating of the flux after tinning.

On the whole, the nitrate process is preferred for tinning cast iron by dipping, and the chloride process for tinning by wiping, but the chloride process is satisfactory for dip-tinning when the castings are sound and well-cleaned mechanically.

Either process can be used satisfactorily for coating cast iron with tin-lead alloys by hot-dipping.

[1] R. Kerr.— "Journal of the Society of Chemical Industry," 1942, vol. 61, p. 181.

[2] B. Chalmers.— "Journal of the Institute of Metals," 1942, vol. 68, p. 253.

CUPOLA OPERATION

(*Continued from page* 432.)

irons last. The charging bogies are made up so that in loading the furnace, which is done by hand charging, steel is charged first followed by the scrap and pig iron. Charges are kept level, and care taken to see that the charge coke is evenly distributed across the whole area. The cupola operates with shallow wells, the content of the well being equal to 2 charges, *i.e.*, 2-ton capacity in the 48-in. dia. cupola and 4-ton capacity in the 66-in. dia. Positive blowers are used for air supply and cupolas are run on constant volume. The air supply is measured by a volume meter and any control by pressure is not permitted.

Slagging

Slagging is continuous after the slag hole has been opened—usually after the third tap. Many people would consider this as very bad practice indeed, but with continuous tapping as practised, it has not been found so. It is the practice to add 4 per cent. air supply to cover this and other losses. When blowing down and coming to the end of a day's melt, no reduction is made in the air supply. During this period there is a more rapid rate of burning, and to overcome the risk of the metal melting too close to the tuyere level, two extra charges of coke are made before the last 4 tons on the 48-in. dia. cupola, and the last 8 tons on the 66-in. dia. cupola. It is during the blowing down period that the tuyeres usually become blocked with slag, and the claim is sometimes made that the volume of air should be reduced in order not to oxidise the metal.

It has always been assumed that as one requires the oxygen for maximum combustion, it must be maintained. If the tuyere area becomes greatly reduced due to closing over with slag, the velocity of air passing the restricted area is increased and this cutting action is neither good for metal nor furnace lining. Therefore, the tuyeres at this stage are cleared. An outline and reasons for established cupola practice have been given and the results over the years are consistent both as regards analyses and physical tests.

FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

MAY 1.

Iron and Steel Institute :—First annual Hatfield Memorial Lecture, "The Services to Metallurgy of the late Dr. W. H. Hatfield, F.R.S.," by Dr. George B. Waterhouse. At the Institution of Civil Engineers, Great George Street, London, S.W.1, at 8.30 p.m.

MAY 2.

Royal Statistical Society (*Industrial Applications section—Sheffield group*) :—"Costs, Overhead Expenses and Effort Assessment in Practice," by F. C. Lawrence. In Room B.1, Department of Mechanical Engineering, The University, St. George's Square, Sheffield, 1, at 6.30 p.m.

MAY 3.

Institution of Mechanical Engineers (*Applied Mechanics' group*) :—"The Design of Flanged Joints," introduced by S. Labrow. At Storey's Gate, St. James's Park, London, S.W.1, at 5.30 p.m.

MAY 4.

Institution of Mechanical Engineers (*Graduates section, London*) :—Annual general meeting. "Surface Finish and its Relation to Production," by H. J. Weighall. At Storey's Gate, St. James's Park, London, S.W.1, at 3.30 p.m.

MAY 10.

Institution of Mechanical Engineers :—Informal meeting, including films of engineering interest. At Storey's Gate, St. James's Park, S.W.1, at 5.30 p.m.

Institute of British Foundrymen

APRIL 27.

Newcastle branch :—Annual meeting. At the Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6 p.m.

West Riding of Yorkshire branch :—Annual general meeting. At the Technical College, Bradford, at 6.30 p.m.

APRIL 30.

London branch :—Annual general meeting. Short Paper competition. At the Charing Cross Hotel, at 7.30 p.m.

IRON & STEEL TO BE NATIONALISED

GOVERNMENT DECISION ANNOUNCED

In the House of Commons last week, Mr. John Wilmot, Minister of Supply, intimated that the Government had decided to nationalise the iron and steel industry. Legislation for the purpose, he said, would be prepared. "The House will remember that on November 19, 1945, in announcing the Government's plans for the socialisation of industries, the Lord President of the Council stated that the Coalition Government had invited the iron and steel industry to submit a report on the improvements required to put the industry on an efficient operating basis, and that H.M. Government proposed to await this report before taking final decisions on the future organisation of the iron and steel industry," Mr. Wilmot said.

"A report prepared by the British Iron and Steel Federation was received and has been considered. It set out plans for the development and modernisation of the industry over the next five to seven years at an estimated cost of £168,000,000. Proposals were also made to effect a certain rationalisation of production in order to achieve maximum plant efficiency. Reports have also been received from the Joint Iron Council dealing with the foundry-iron and ironfoundry sides of the industry.

Reports "Welcomed"

"The Government welcome these reports as an important contribution to the planned development of this basic industry.

"After full consideration, the Government has reached the conclusion that the position of the industry and its importance in the national economy necessitate a large measure of public ownership and that legislation for this purpose should be prepared.

"Meanwhile, immediate discussion will take place to ensure that urgent modernisation and development schemes are carried through without delay. The Government are anxious to secure the utmost co-operation of both managements and workers during the period which will be necessary for the preparation and putting into effect of the scheme of public ownership. For this period I propose to establish a Control Board. This Board will replace the existing Iron and Steel Control and will be responsible to me for the general control and supervision of the industry. The Board will pay special attention, in consultation with the industry, to facilitate the early execution of the urgent development schemes. The Board will also act as my advisers on questions arising in the preparation of the scheme of nationalisation, including the definition of the sections of the industry to be taken into public ownership."

Steel Industry's View

The following statement was issued by Mr. Ellis Hunter, president of the British Iron and Steel Federation:—"The iron and steel industry emerged from the war with an enviable record of achievement in meeting the country's requirements. Current production is high in spite of shortages of fuel and imported ore, and an outstanding contribution has already been made to the exports of the country. The record of relations between labour and management in the iron and steel industry is one of which all engaged in it are proud.

"The nation had in wartime the benefit of the progress in the industry made in the five years before the war, when efficient and up-to-date plants were built in various parts of the country. During the war—as a matter of national policy—the industry's modernisation programme had to be suspended for the time being. The industry has welcomed, therefore, the opportunity of putting before the Government its own proposals for further modernisation and systematic development over the next five years. These plans are far-reaching in their range and effect. They are based upon the highest technical advice. In its relations with the Government, the industry has always responded to the opportunity of disclosing fully its plans and policies with a view to keeping these in line with the best interests of national requirements.

"The iron and steel industry believes that achievement of the highest standards of efficiency and quality can be secured by continuity in the policy pursued by the Government and the industry together before the war. It cannot support a policy of public ownership as contributing to these ends and views with the greatest concern a period of acute controversy on matters of ownership in this highly complex industrial structure, controversy which will divert efforts from the true needs of the nation and disturb confidence in a very wide range of allied trades."

EALING PARK FOUNDRY

Qualcast, Limited, of Derby, have completed the purchase of the whole of the share capital of Ealing Park Foundry, Limited, which is well known in the foundry industry as a company turning out high-quality products, specialising in high-duty material up to 30 tons tensile strength. Mr. R. B. Templeton remains as chairman and managing director, and Mr. J. F. Chambers, the present works manager, joins the board. Mr. R. Hammond, who has been chief accountant at Ealing Park Foundry, becomes secretary. Later, there may be additions to the board from other members of the Qualcast group.

THE SECOND INTERIM REPORT of the Committee appointed by the President of the Board of Trade to inquire into the changes necessary in the Patents and Designs Acts and the practice of the courts in connection therewith has now been published. The report deals mainly with the question of the abuse of monopoly rights in connection with patents and with the trial and cost of patent actions. Copies of the Report (Cmd. 6789) are obtainable, price 9d. (by post 11d.), from H.M. Stationery Office. The Committee are now able to consider proposals for the amendment of the law of patents and designs outside the particular subjects dealt with in the present report. Anyone wishing to submit suggestions for consideration by the Committee should communicate with the secretary of the Patents Committee, 1944, 25, Southampton Buildings, London, W.C.2.

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PERSONAL

MR. BEN GARDNER, of Manchester, has been re-elected general secretary of the Amalgamated Engineering Union.

SIR CHARLES BRUCE-GARDNER has accepted a seat on the boards of Guest, Keen & Nettlefolds, Limited, and John Lysaght, Limited.

MR. R. C. TUCKER is now foundry manager to James & Company (Birmingham), Limited, Manor Lane, Halesowen, Worcs.

MR. EVERARD P. MAJOR has joined the board of J. M. Tew & Rhoden, Limited, scrap merchants, of Coneygree Road, Tipton, Staffs.

MR. K. T. BOARDMAN has been appointed a director and financial manager of Mann, Egerton & Company, Limited, electrical engineers, etc., of Norwich.

MR. N. M. PEECH, chairman and managing director of the Steetley Company, Limited, has joined the board of the Sheepbridge Coal & Iron Company, Limited.

MR. W. M. GOOD has resigned his directorship of the Brush Electrical Engineering Company, Limited, and also the managing directorship of Brush Coachwork, Limited.

MR. HARRY KAHN has resigned from the board of Aron Electricity Meter, Limited, of Kilburn, London, N.W.6. MR. E. D. A. HERBERT has been appointed in his stead and elected chairman.

MR. JOHN TORRANCE, of the Ambulance Brigade of Smith & Wellstood, Limited, stove and boiler manufacturers, etc., of Bonnybridge, Stirlingshire, has been awarded the King's Medical Service Medal.

MR. W. H. LAKE, a director of the Shelton Iron, Steel & Coal Company, Limited, has received a cheque and a silver perpetual calendar on his retirement after 38 years' service with the company.

MR. RALPH ALSOP, who has retired from the position of managing director of the Consett Iron Company, Limited, was recently presented with parting gifts as a token of appreciation at the company's head office.

MR. A. ELLIS, managing director of Peglers, Limited, Doncaster, has been elected president of the National Brassfoundry Association. He has resigned his post as chairman of the Northern Brassfounders' Employers' Association.

MAJOR S. D. DUNCAN, a director of Albright & Wilson, Limited, manufacturers of phosphorus and its compounds, of 52, Grosvenor Gardens, London, S.W.1, has been elected honorary treasurer of the Anglo-Chinese Chamber of Commerce.

SIR FREDERICK C. STEWART, chairman of Kelvin, Bottomley & Baird, Limited, Thermotank, Limited, Thermotank Engineering Company, Limited, deputy-chairman of Brown Bros. & Company, Limited, and a director of the North British Locomotive Company, Limited, and other companies, is to receive the honorary degree of Doctor of Laws from Glasgow University.

MR. H. SPEED PEACOCK, who retired from the position of general manager of Guest, Keen & Nettlefolds, Limited, Castle Works, Cardiff, was entertained at luncheon in London recently by the chairman and board of directors, who presented him with an antique silver salver. Mr. Peacock will continue to be associated with the firm as a director of certain subsidiary companies.

SIR JAMES LITHGOW, Controller of Merchant Shipbuilding and Repairs at the Admiralty from 1940 to 1946, is to receive the honorary degree of Doctor of Laws from Glasgow University. He is chairman of William Beardmore & Company, Limited, the Steel Company of Scotland, Limited, Fairfield Shipbuilding & Engineering Company, Limited, and is a member of the boards of many other companies.

MR. F. J. COOK, M.I.Mech.E., who was a founder of both the Institute of British Foundrymen and the British Cast Iron Research Association, and a past-president of the I.B.F., is resigning his position as consultant with the B.C.I.R.A., which he has held for many years, on June 20 next. He will, however, keep in touch with the work of the Association by remaining on four of its committees, and will continue his business as a foundry consultant.

MR. GEORG REHDER, for many years managing director of Uddeholm General Agencies, Limited, Swedish charcoal steels and tubes, etc., of Somerset House, Temple Street, Birmingham, 2, left this country recently for the United States, where he will take control as president of the Uddeholm Steel Company of America, Inc. The British organisation will carry on under the control of MR. CECIL W. ROBINSON and MR. A. HORNBY RATHBONE as joint managing directors.

COMBUSTION APPLIANCE MAKERS

The annual report of the Combustion Appliance Makers' Association (Solid Fuel) states that, despite the difficulties of the times, the work of the Association has been carried on without relaxation of any of their activities. There has been a considerable growth in the attention given to their external relations with the Ministries and public authorities, whereas in previous years the larger part of their work lay within the affairs of the industry itself.

Opportunity has been taken to make a direct representation to the Ministry of Fuel and Power setting forth those factors which, in their opinion, are a present setting a limit to the efficient development of appliances. It was pointed out that while the nature of fuel supplies was uncertain, manufacturers must design on a compromise basis which inevitably meant the sacrifice of otherwise attainable efficiency. Emphasis was also laid on the part which the price structure of coal plays in the development of appliances and the lack of an incentive to the production of new designs when uncertainty exists as to how far relative prices can be regarded as stable. The Association also represented that if the national fuel resources were to be utilised to the greatest advantage it was essential for continuity of regular supplies to be assured to those plants which could make the most efficient use of them.

Mr. S. McEwen is the new president of the Association.

Design by Victor Reinganum

MOSAICS OF STEEL

NUMBER THREE

The Steel, Peech and Tozer plant at Templeboro is for size unequalled in the country, and its products serve an unlimited number of industries. The large scale continuous rolling plants were the first of their kind installed in Britain and they are constantly being brought up-to-date to cater for the progressive needs of steel users. The products are supplied for further rolling, forging, stamping and other kindred processes to supply the components of a host of dependent industries. Some of the output of the Templeboro plant is taken by associated and adjacent plants for rolling into bar and strip. These rolled products find their way by many channels of manufacture into the engineering and hardware trades as component parts of mechanical, electrical, transport equipment and domestic utility. At the Ickles works, steel is made for processing in the heavy forging plant. Steel, Peech and Tozer are world famous for the quality of their railway products—tyres, wheels, axles and springs.

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NEWS IN BRIEF

RAYNE FOUNDRY, LIMITED, is to be wound up voluntarily. Mr. L. J. Cozens, 8, East Stockwell Street, Colchester, is the liquidator.

OUR SCOTTISH CORRESPONDENT reports that because of the lack of baths and firegrates, the Swedish-built permanent prefabricated houses erected in Falkirk cannot be used, and the Ministry of Works holds out but little hope of delivery for many months.

THE CENTRAL PURCHASING DEPARTMENT of Imperial Chemical Industries, Limited, which was dispersed throughout the war, is being reassembled in London at Ravensbury Terrace, Earlsfield, S.W.18. The engineering supplies section, which has been located at Northwich, will operate from the new address on and from April 29.

A FURTHER MEMORANDUM (No. 9) on electrodeposition has been released by the Ministry of Supply, "Machining Before and After Repair by Electrodeposition." Copies may be obtained on application to the Secretary, Electrodeposition Technical Advisory Committee, c/o S.T.A.M., 623, Berkeley Court (S.W. Wing), Glentworth Street, London, N.W.1.

THE COUNCIL of the British Engineers' Association have invited Mr. S. F. Steward, a director of E. R. & F. Turner, Limited, milling machinery makers, ironfounders, etc., of Ipswich, to fill a casual vacancy on the Council created by the resignation of Mr. F. Ayton. Mr. Steward recently relinquished his post as Director-General of Machine Tools and is chairman of the newly established Machine Tool Advisory Council.

A CALL FOR A WIDE development of research facilities in technical colleges is made to local education authorities by the Ministry of Education in a circular issued recently. Miss Ellen Wilkinson, Minister of Education, has informed education authorities that she considers it a matter of the highest importance that industry, commerce, the professions and the universities should be more closely associated with the management of the major technical colleges.

DURING THE HEARING of an application before the Irish Wages Advisory Tribunal that the supplementary bonus of 60 general workers employed in the steel mills of Irish Steel, Limited, Haulbowline, Cork, be raised from 11s. to 16s. weekly, it was revealed that the company was producing steel at a loss. The present stock of billets, obtained at a high cost, would be exhausted by about the middle of May, and it would then be possible to produce more cheaply.

PARTICULARS OF A NEW SCHEME which is to come into operation on May 1 to assist the resettlement of workers who, with the approval of the Ministry, transfer permanently to a new area, were announced by the Minister of Labour and National Service in the House of Commons last week. There is also to be a special scheme for assisting the transfer of unemployed workers to temporary employment in a new area while awaiting the development of new industries in their home area. This is to be introduced immediately.

MR. T. MEEHAN, divisional organiser of the Iron and Steel Trades Confederation, told the annual conference of branch officers of the union, held at Redcar recently, that discussions have taken place between the Confederation and the steel trade employers on the workers' demand for the retention of the principle of the guaranteed week after the termination of the Essential Work Order on May 15. No agreement had yet been reached. Their members were looking forward to the implementation of the shorter working week and a revision of their rates of pay, he added.

THE MOND NICKEL COMPANY, LIMITED, announce the appointment of delegate boards of directors for their subsidiary companies, Henry Wiggin & Company, Limited, and Birlec, Limited. The board of Henry Wiggin & Company consists of Dr. W. T. Griffiths, chairman; Mr. I. A. Bailey, managing director; Mr. L. H. Cooper, secretary; Mr. A. P. Hague, Mr. R. A. R. Hill, Mr. R. M. Parry and Dr. L. B. Pfeil. The Birlec board consists of Dr. W. T. Griffiths, chairman; Mr. A. Glynne Lobley, managing director; Mr. L. H. Cooper, Mr. G. P. Tinker, Mr. T. G. Tanner, Mr. J. H. Crossley and Mr. F. Kerfoot.

RELEASES UNDER CLASS "B"

A letter issued by the Council of Ironfoundry Associations states that it was originally stipulated by the Ministry of Labour that only applications for release in respect of men who were over 21 years of age and had served at least one year in the Forces were eligible for consideration for release under Class "B." As a result of negotiations which have taken place and expressions of opinion by the C.F.A. and the Iron and Steel Control, it has now been agreed that so long as men have served one year in the Forces, applications will be considered for men who are under 21 years of age, and the appropriate department of the Iron and Steel Control have now sent forward for Class "B" release applications for men under 21 which previously could not be considered.

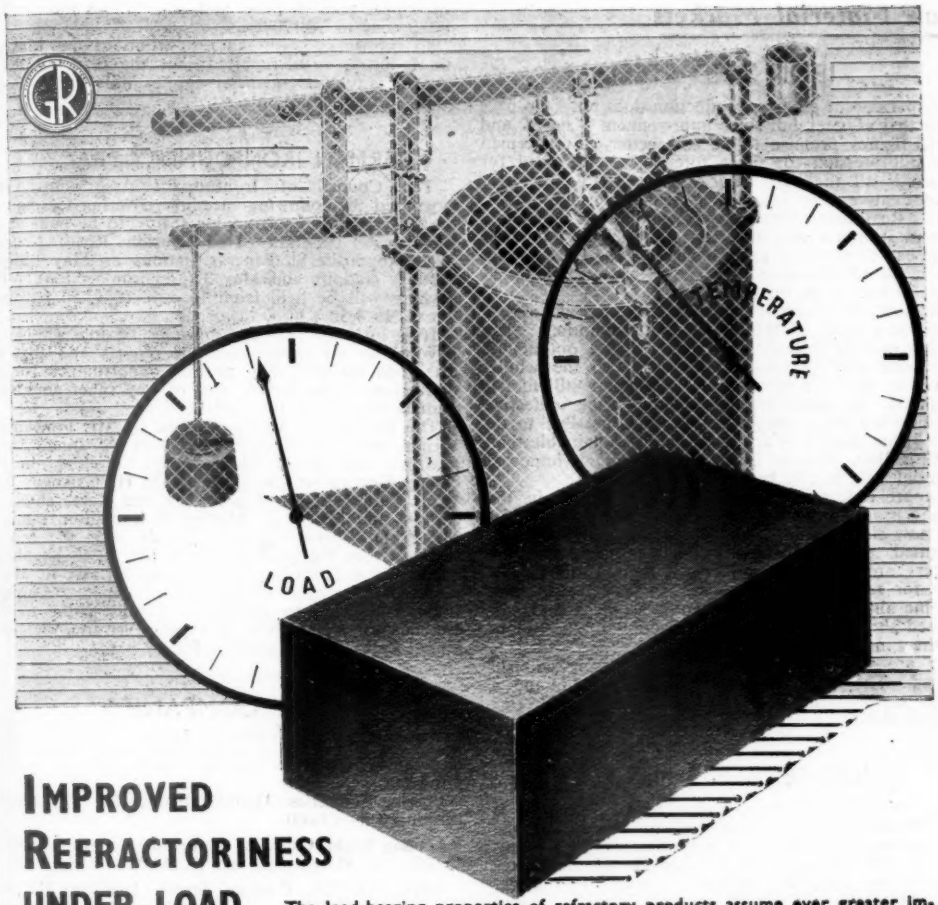
If ironfounders have any fresh cases which they require to submit, it is suggested they make contact with the Labour Officer of the Ministry of Supply, Iron and Steel Control, Ashorne Hill, near Leamington Spa, as soon as possible.

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Brinscall, May 11—Iron fencing, for the Withnell Urban District Council. Mr. C. L. Gregson, surveyor, Council Offices, School Lane, Brinscall, near Chorley, Lancs. (Fee £2 2s., returnable.)

London, May 13—Road gullies, pipes, bends, etc., gully grates and drains, and manhole covers, for nine months from July 1, for the Camberwell Borough Council. Mr. William Bell, borough engineer and surveyor, Town Hall, Camberwell, London, S.E.5.



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Raw Material Markets

IRON AND STEEL

Expansion of pig-iron production does not keep pace with that of steel, but some improvement is noted, and April figures promise to be still better. Furnacemen are still pressing for more foreign ore, the need for which is all the more urgent since the use of low-grade native ores involves a higher consumption of fuel. Reasonable tonnages of hematite and low-phosphorus iron are available, but of late the foundries have had to encroach upon their stocks and are hoping for more liberal allocations now that an additional blast furnace is in operation.

Imports of semi-finished steel now represent a very small proportion of the aggregate consumption. Re-rollers are increasingly dependent on the outputs of the home steel plants, and although, on the whole, deliveries are on a better scale, consumers still find it necessary to augment supplies by using defective double-sawn crops, etc., whenever it is possible to do so. Prime sheet bars are more readily obtainable than small billets, and it is hoped that more imported material will shortly become available.

Export orders for plates still bulk largely in the rolling programmes, but the needs of home industries are now rising rapidly, and order-books are so overweighted, particularly for the lighter sizes, that the makers are reluctant to increase their commitments even for remote delivery dates. Plates have, in fact, become almost as strong a feature as black and galvanised sheets, although only a fraction of the output of sheet mills is being released for export, whereas there are still big tonnages of plates being shipped abroad. The section mills are fully engaged, and a steady demand for steel rails, colliery material, etc., is maintained.

NON-FERROUS METALS

The reopening of the London Metal Exchange is still apparently under consideration, but so far the Government have given no indication of their intentions in this matter. The intervention of the Easter holidays has naturally curtailed business this week, while buyers have displayed caution since the revised price levels of copper, zinc and lead were announced.

The Ministry of Supply are to purchase 30,000 tons of Chilean copper in the first half of 1946 following prolonged negotiations between the two Governments.

Consumption of virgin copper in the United Kingdom, according to the British Non-Ferrous Metals Federation, amounted to 24,920 tons in March, compared with 21,790 tons in February, making 74,470 tons for the first quarter of the year. Consumption of scrap copper rose 1,090 tons further to 14,080 tons. Of the total consumption of 39,000 tons, unalloyed copper products accounted for 21,550 tons, a rise of 2,660 on February, due chiefly to a higher output of strip and sheet and high-conductivity rods and strip. The amount of copper used in brass and other alloys increased by 1,270 tons to 16,170 tons.

In connection with the restoration of the Malayan tin industry, it is reported that the British Government has offered financial aid to Malayan producers at a cheap rate of interest.

GERMAN IRONFOUNDRY PRACTICE

The Council of Ironfoundry Associations have organised the following meetings covering German investigation and requisitioning teams, to be held at the St. Pancras Assembly Hall, Euston Road, London, W.C.1 (opposite St. Pancras Station), on May 2 (light-castings section), and May 3 (grey-iron section). The sessions will be held from 10 a.m. to 12.30 p.m. and 2 p.m. to 4.30 p.m.

It is intended that the morning sessions should be devoted to the presentation of reports and that the afternoon sessions shall provide opportunities for the discussion of the reports and of any other important matters relating to the visits.

The first session will be opened by Mr. FitzHerbert Wright, president of the C.F.A., with Mr. James Shaw, chairman of Allied Ironfounders, Limited, in the chair. Reports will be given by Dr. H. T. Angus, Mr. W. B. Parkes, of the British Cast Iron Research Association, and Mr. B. E. Martin, of Radiation, Limited. Mr. J. D. Carmichael will preside over the second session, when the speakers will be Mr. R. C. Shepherd, of Ruston & Hornsby, Limited, and Mr. W. R. Marsland, of Newman, Hender & Company, Limited. Readers desiring to participate should write to the secretary of the C.F.A., Derbyshire House, Belgrove Street, Kings Cross, London, W.C.1.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Forster Foundries, Daimler House, Paradise Street, Birmingham—£5,000.

Lennox Light Castings, Camp Road, Motherwell—£4,000. G. M. Lennox and R. A. M'Donald.

Pidco, 116-126, Cannon Street, London, E.C.4—Engineers, etc. £2,000. A. Rawlins and C. H. Brand.

Harold Chell & Company, Sylvanese Works, Knighton Lane, Leicester—Engineers, etc. £2,000. H. Chell.

A. E. Aspinall, 16, Cumberland Street, Manchester—Textile engineers, etc. £5,000. A. E. and K. M. Aspinall.

Metallic Construction Company (Manchester), 6, Brown Street, Manchester, 2—£2,000. R. W. Strawson and H. J. Bullen.

R.C.M. Products, Great North Road, Barnet—Engineers, etc. £5,010. C. W. Chambers, N. G. Manakee, and L. L. Roberts.